

Decision Rationale

Total Maximum Daily Load of Fecal Coliform for the Middle Segment of the Blackwater River

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by the state where technology-based and other controls did not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for establishing the TMDL of Fecal Coliform for the middle segment of the Blackwater River. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1. The TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDL considers the impacts of background pollutant contributions.
4. The TMDL considers critical environmental conditions.
5. The TMDL considers seasonal environmental variations.
6. The TMDL includes a margin of safety.
7. The TMDL has been subject to public participation.
8. There is reasonable assurance that the TMDL can be met.

II. Background

Located in Franklin County, Virginia, the overall Blackwater watershed is approximately 108,000 acres. The middle segment of the Blackwater River watershed comprises 23,206 acres. The TMDL addresses 15.78 stream miles from the confluence of Hays Run and the Blackwater River to the end of Rt. 921. Forest is the major land use in the watershed and makes up roughly 55% of the 23,206 acre watershed.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 15.78 miles of the middle segment of the Blackwater River as being impaired by elevated levels of fecal coliform on Virginia's 1998, Section 303(d) list. The middle segment of the Blackwater River was listed for violations of Virginia's fecal coliform bacteria water quality standard and the general (benthic) water quality standard. Fecal Coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in

itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli (and enterococci) and the incidence of gastrointestinal illness. The Commonwealth is pursuing to change the standard from fecal coliform to e-coli.

Virginia designates all of its waters for primary contact, therefore, all waters must meet the current fecal standard for primary contact. Virginia's standard is to apply to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions alone (wildlife contributions to the streams) could cause violations of the standard during low flows. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the stream. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will reduce all sources of fecal coliform to the stream other than wildlife. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. During Phase 2, the Commonwealth has indicated that it will evaluate the following items in relation to the standard. 1) The possibility of placing a minimum flow requirement upon the bacteriological standard. As a result, the standard may not apply to flows below the minimum (possibly 7Q10). This application of the standard is applied in many States. 2) The Commonwealth may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated primary contact infrequent bathing. 3) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation rate associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2 further work and reductions will be warranted.

The middle segment of the Blackwater River identified as watershed VAW-L08R, was given a high priority for TMDL development. Section 303 (d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the

state where technology-based and other controls do not provide for the attainment of water quality standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to the middle segment of the Blackwater River, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)¹, in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.² Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, wildlife in-stream, and straight pipes.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr) 1
South Fork	Fecal Coliform	4.09E+14	2.80E+09	4.06E+14	2.57E+12
North Fork	Fecal Coliform	9.27E+14	0.00	9.24E+14	2.98E+12
Upper Blackwater	Fecal Coliform	3.34E+15	0.00	3.34E+15	7.06E+12
Middle Segment	Fecal Coliform	2.75E+15	9.83E+10	2.74E+15	3.59E+12
Total	Fecal Coliform	6.09E+15	10.11E+10	6.08E+15	1.06E+13

¹ Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

EPA believes it is important to recognize the conceptual difference between the wasteload allocation (WLA) values, load allocation (LA) values for sources modeled as direct

¹Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

²CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

deposition to stream segments, and LA values for flux sources of fecal coliform to land use categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. However, LA values for flux sources represent amounts of fecal coliform deposited to land. The actual amount of fecal coliform which reaches the stream segments will be significantly less than the amount of fecal coliform deposited to the land. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segments. The LA in Table 1 is the amount of cfu reaching the stream from nonpoint sources annually.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for the middle segment of the Blackwater River. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited into the River) have caused violations of the water quality standards and designated uses on the middle segment of the Blackwater River. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Therefore, most violations of the state's water quality standard are due to violations of the instantaneous standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to the middle segment of the Blackwater River will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Information is attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc. This information was put into the model. The model then combines all the data to determine the hydrology and water quality of the stream.

The hydrology component of the model for all the Blackwater TMDLs was developed on United States Geologic Survey (USGS) gage #02056900 on the Blackwater River. This was done because there were no stream gages on the other waters. The percent error of the simulated

flow versus observed flow was within the acceptable limit. The model was calibrated to USGS gage #02056900 data from October 01, 1994 through September 30, 1998. The model was then validated, applied to a different time period to determine if it still simulated observed data, to USGS gage #02056900 data from January 01, 1991 to September 30, 1994 and October 01, 1980 to September 30, 1981. The instantaneous water quality sampling was used to determine an average ratio of flow at the VADEQ monitoring stations to the gage station. This process was then conducted for the simulated flow measurements. These ratios were then evaluated to determine the accuracy of the model on a finer (subwatershed) scale. The model was transferred to the subwatersheds to determine the fecal coliform loading. Parameters such as the fecal coliform concentration in interflow, the intensity of rainfall that will cause 90% of the pollutant to be washed off, decay rate, and the maximum accumulation of a pollutant on the land surface were changed to create a better correspondence between observed and simulated conditions.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for the middle segment of the Blackwater River.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based, precipitation driven nonpoint source areas (impervious areas, built-up area, distributed area, field crop, forest, hayfield, improved pasture, overgrazed pasture, poor pasture, row crop, strip crop), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, straight pipes, and lateral flow), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there are five point sources discharging to the middle segment of the Blackwater River. The permitted point sources are Franklin Ford-Mercury, Rocky Mount Water Treatment Plant, Franklin Manor Nursing Home, Hammock Trailer Park, and single family home treatment plant (operating under Virginia General Permit #VAG0402007). Franklin Manor Nursing Home, Hammock Trailer Park, and a single family home are the only point sources permitted to discharge fecal coliform in their effluent. Table 2 documents the WLAs for these facilities. The Manor Nursing Home is not currently discharging to the middle

segment of the Blackwater River. However, it was LA a load equal to its design flow (0.015 mgd) multiplied by its permitted effluent concentration of 200 cfu/ 100mL. The Hammock Trailer park allocated load was equal to its design flow (0.0195 mgd) multiplied by its permitted effluent concentration. It is important to note that the Trailer Park is required to chlorinate and in all likelihood is delivering a fecal coliform load below its permitted limit. The single family home was assigned a WLA of 2.76E+9 which is equal to its design flow (1,000 gallons per day) multiplied by its effluent concentration of 200 cfu/ 100 mL. The single family home was deemed insignificant and not included in the model because the discharge is less than 3% of the total WLA and .0001% of the TMDL. The Callaway Elementary School which discharges to the South Fork of the Blackwater is also listed in Table 2.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), “Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7.” Furthermore, EPA has authority to object to the issuance of any National Pollution Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - Waste Load Allocations for the Middle Segment of the Blackwater

Facility	Permit Number	Existing Load	Allocated Load
Franklin Manor	VA0067555	4.15E+10	4.15E+10
Hammock Trailer Pk.	VA0086614	5.40E+10	5.40E+10
Single Family Unit	VAG42007	2.76E+09	2.76E+09
Callaway Elementary School	VA0088561	2.80E+09	2.80E+09
Total	N/A	10.11E+10	10.11E+10

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading; wherever possible natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the middle segment of the Blackwater River watershed. The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants

and toxicants³. More specifically HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to the middle segment of the Blackwater River from impervious areas, built-up area, distributed area, field crop, forest, hayfield, improved pasture, overgrazed pasture, poor pasture, row crop, strip crop. The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle and wildlife (geese, deer, etc.) to the land, fecal coliform production from dogs, and best management practices which have already been implemented on several farms reduce the loading of fecal coliform and sediment to streams.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, wildlife in-stream, and failed septic systems. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore can impact water quality during low and high flow events. Table 3 illustrates the LA for the land application of fecal coliform, the loading to each land use. The load that reaches the stream from each land use will be significantly smaller than the amount of fecal coliform deposited to the land, quantities listed in the table. The allocated load in livestock access areas increased due to the removal of cattle from the stream.

Table 3 - Load allocation for the land application of fecal coliform

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Good Pasture	1.04E+16	1.04E+16	0%
Poor Pasture	1.18E+14	1.18E+14	0%
Cropland	4.19E+16	4.19E+16	0%

³ Supra, footnote 2.

Forest	7.85E+14	7.85E+14	0%
Urban	1.07E+15	1.07E+15	0%
Farmstead	5.23+E13	5.23+E13	0%
Livestock Access	3.22E+14	1.05E+15	-225%
Loafing Lot	1.72E+15	1.72E+15	0%
Straight Pipes	1.14E+13	0.0	100%
Lateral Flow	6.43E+08	6.43E+08	0%
Wildlife In-Stream	9.39E+12	6.10E+12	35%
Cattle In-Stream	7.24E+14	0.0	100%

This table documents the allowable loading to each land use, a significantly smaller amount of fecal coliform will reach the stream .

3) The TMDL considers the impacts of background pollution.

A background concentration was set for all land segments by adding 10% of the total wildlife load to each land segment.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the middle segment of the Blackwater River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards⁴. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable “worst-case” scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for the middle segment of the Blackwater River was represented as a typical hydrologic year. However, the most stringent reductions were needed to insure that water quality standards were met during extreme low flows. A twenty-year low flow event in 1991 dictated the reductions needed in order for the stream to attain standards. It should be noted that low flow events occurred more often than wet weather events and therefore it was essential that the standard be maintained during these periods.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the

⁴EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

year. For example, cattle spent more time in the stream in the summer and animals were confined for longer periods of time in the winter.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) The TMDLs have been subject to public participation.

Three public meetings were held to discuss the TMDL and TMDL process. The meetings were held on November 04, 1999, February 16, 2000, and March 15, 2000 and were intended to address initial questions and concerns regarding outreach issues and the TMDL process. All meetings were advertised in the Virginia Register and Franklin News Post. Two special one-hour programs and the February 16, 2000, public meeting were televised to 8,500 households with cable television access.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to the 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that because of the violation rate associated with the wildlife loadings and/or because of any modifications that may have been made, that Phase 1 of the

implementation process will allow the middle segment of the Blackwater River to attain standards. The Commonwealth is investigating possibly changing the use of these waters, adding a minimum flow component, or having a natural condition amendment added to their standards.